Original Article

Self-inflicted injuries are an important cause of penetrating traumatic injuries in Japan

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Aim: Japan has a low crime rate, but a high suicide rate. The aim of this study is to review the causes of penetrating traumatic injuries in a tertiary care emergency center in Japan.

Methods: We retrospectively reviewed all admissions for traumatic injuries over a 3-year period, and calculated the proportion of patients with penetrating traumatic injuries. Weapon used, age, gender, Injury Severity Score, cause of injury, and site of injury in all patients with penetrating injuries were reviewed. The proportion of patients with penetrating injuries among patients with all types of traumatic injuries requiring surgical intervention was calculated.

Results: Of 1,321 patients admitted over 3 years, 65 patients (5%) suffered from penetrating injuries. Most were stab wounds, with only one gunshot (2%). The most common site of injury was an extremity (48%). The most common cause of penetrating injury was self-inflicted (38%). The abdomen is the most common site injured among self-inflicted injuries. Of patients with all types of traumatic injuries requiring surgical intervention, penetrating injuries accounted for 23%.

Conclusion: Penetrating injuries represent 23% of all patients with traumatic injuries who required surgical intervention. Self-inflicted penetrating injuries were most common, supporting the need for preventive services. Acute care surgeons must be familiar with the surgical management of penetrating traumatic injuries, even in a country with a low crime rate.

Key words: Crime rate, penetrating injury, self-inflicted injury, stab wound, suicide

INTRODUCTION

JAPAN HAS A very low crime rate, with few injuries due to assaults. The murder rates in Japan and the USA were 0.9 and 4.8 per 100,000, respectively, in 2010.[1] There were just 19 murders with guns in Japan in 2010,[2] a country of approximately 127 million people, while there were 8,874 in the USA in the same year, with a population of approximately 310 million.[3] This is partly due to the fact that it is illegal for individuals to possess or use firearms for any reason in Japan, and there is nearly perfect compliance with this law. There were 557 murders with knives in Japan in 2011,[4] whereas in the USA there were 1,716.[3] The incidence of penetrating traumatic injuries remains very low and contributes to the fact that most surgeons have very little experience in the management of penetrating traumatic injuries in Japan.

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However, surgeons in Japan may encounter penetrating traumatic injuries requiring surgical intervention due to suicide attempts. In Japan, there is a relatively high rate of suicide attempts.[5] Suicide is a major social problem in Japan with more than 15,000 people taking their own lives every year.[5] This is approximately three times more than the number of traffic accident deaths. Suicide is the leading cause of death in people from 15 to 39 years old in Japan. The means of attempting suicide in Japan include self-inflicted penetrating injuries, toxin ingestion, falls, and hangings. There are no reports about this psychiatric–surgical problem in this country with low crime but high suicide rate.

The objective of this study is to clarify the epidemiology of penetrating traumatic injuries and self-inflicted penetrating injuries in a tertiary care emergency center in Japan, especially with regard to injuries requiring surgical intervention.

METHODS

WE RETROSPECTIVELY REVIEWED all patients admitted with traumatic injuries from January 2012

through December 2014 at a 1,000 bed tertiary care medical center, serving a suburban area with a population of approximately 500,000 people. Review of patient data was approved by the Institutional Review Board. All patients with penetrating injuries admitted during the study period were reviewed. Age, gender, Injury Severity Score (ISS), injury site, weapon used, and cause of injury were reviewed. We investigated the proportion of patients with self-inflicted penetrating injuries, and compared age, gender, ISS, and injury site between self-inflicted penetrating injuries and other causes (accident, work-related, and assault).

Among patients who suffered penetrating injuries, we collected data regarding indications, operative findings, and the nature of surgical procedures for patients who required surgical intervention. Patients requiring surgical intervention were defined as those who underwent thoracotomy, laparotomy, or surgical procedures for injuries with an ISS ≥9 to the neck and extremities, proximal to the knees or elbows. Patients treated only with radiological interventions, such as angioembolization or stenting, were excluded from the surgical intervention group. To calculate the total proportion of patients in the surgical intervention group, patients who suffered blunt traumatic injuries requiring surgical operation were reviewed.

Table 1. Demographic data of patients with penetrating injuries treated in a tertiary care emergency center in Japan

Number of penetrating injuries	65 (100%)
Age, mean ± SD	47.0 ± 18.8
Number of male patients	50 (77%)
Injury Severity Score, mean ± SD	5.4 ± 5.7
Mechanism of injury	
Gunshot wound	1 (2%)
Stab wound	64 (98%)
Injury site	
Extremity	31 (48%)
Abdomen	15 (22%)
Neck	8 (12%)
Head and face	4 (6%)
Chest	3 (5%)
Back	1 (2%)
Extremity and neck	1 (2%)
Abdomen and neck	2 (3%)
Cause of injury	
Self-inflicted	25 (38%)
Accident	19 (30%)
Work-related	13 (20%)
Assault	8 (12%)

Statistical analysis

Data for patient age and ISS were analyzed using the Mann–Whitney *U*-test. Gender and injury site were evaluated with Fisher's exact test (Excel; Microsoft, Redmond, WA USA). Data are reported with the mean, standard deviation, and *P*-value.

RESULTS

DURING THE STUDY period, 1,321 patients were admitted with traumatic injuries, of which 65 (5%) suffered penetrating injuries. Of the 65 patients with penetrating injuries, 64 (98%) patients suffered stab wounds and 1 (2%) had a gunshot wound (assault). Patient characteristics, including mean age, gender, mean ISS, most frequent injury site, and most common cause of injury, are shown in Table 1.

Table 2 compares age, gender, and ISS for patients who had self-inflicted injuries with those injured by other causes (accident, work-related, and assault). There were no significant differences between the two groups regarding age and ISS, but there was a significant difference in gender. Most accidents were associated with home activities, such as gardening with lawnmowers or home carpentry with saws. Work-related injuries most commonly occurred at construction sites or factories, and most of these patients were male. All patients who were assaulted were men.

Table 3 compares the sites of injury between self-inflicted penetrating injuries and those from other causes. The data show that the most common site of injury in patients who suffered self-inflicted penetrating injuries was the abdomen. The extremity was the most frequent site in patients suffering injuries from other causes. There were significant differences between the proportion of abdomen and extremity injuries in the two groups.

Table 2. Comparison of age, gender, and Injury Severity Score (ISS) between self-inflicted penetrating injuries and other causes of injury (accident, work-related, and assault)

	Self-inflicted (n = 25)	Others (n = 40)	*P*-value
Age, mean ± SD	49.2 ± 16.7	45.6 ± 20.0	>0.05†
Number of men	14 (56%)	36 (90%)	<0.01‡
ISS, mean ± SD	6.4 ± 7.0	4.7 ± 4.8	>0.05†

†Mann–Whitney *U*-test; ‡Fisher's exact test.

Table 3. Comparison of site of injury between self-inflicted penetrating injuries and injuries from other causes (accident, work-related, and assault)

Self-inflicted (n = 25)		Other causes (n = 40)		P-value
Abdomen	10 (40%)	Abdomen	5 (13%)	<0.05†
Extremity	6 (24%)	Extremity	25 (63%)	<0.01†
Neck	6 (24%)	Head and face	4 (10%)	
Extremity and neck	1 (4%)	Neck	2 (5%)	
Chest	1 (4%)	Chest	2 (5%)	
Abdomen and neck	1 (4%)	Abdomen and neck	1 (3%)	
		Back	1 (3%)	

†Fisher's exact test.

Table 4 shows demographic data for 18 patients with penetrating injuries who underwent surgical intervention. The acute care surgeons in this facility carried out surgical operations in 59 patients with blunt injuries during the same period, thus the proportion of surgical interventions for penetrating injuries among all patients with injuries to the neck, chest, abdomen, and proximal extremities was 23%. Table 5 shows the surgical indications, operative findings, and surgical procedures in patients with penetrating injuries who underwent surgical intervention. The most common

Table 4. Demographic data of patients with penetrating injuries requiring thoracotomy, laparotomy, or a surgical procedure of the neck or extremities proximal to knees or elbows, with an Injury Severity Score (ISS) ≥9

Number of patients with penetrating injuries requiring surgical intervention	18
Age, mean ± SD	53.8 ± 19.3
Number of male patients	15 (83%)
ISS, mean ± SD	11.3 ± 7.4
Mechanism of injury	
Gunshot wound	0 (0.0%)
Stab wound	18 (100.0%)
Site of injury	
Abdomen	11 (61%)
Neck	4 (22%)
Back	1 (6%)
Extremity (thigh)	1 (6%)
Neck and abdomen	1 (6%)
Cause of injury	
Self-inflicted	12 (67%)
Assault	4 (22%)
Work-related	1 (6%)
Accident	1 (6%)

Table 5. Surgical indications, findings, and procedures in patients with penetrating injuries requiring thoracotomy or laparotomy, or a surgical procedure for an injury with an Injury Severity Score ≥9 to the neck or extremities proximal to knees or elbows

Number of patients with penetrating injuries requiring surgical intervention	18
Indications for surgery	
Shock	11 (61%)
Peritoneum or platysma violation	4 (22%)
Perforation of the digestive tract	2 (11%)
Cardio-pulmonary arrest	1 (6%)
Operative findings (multiple answers allowed)	
Transection of the external jugular vein	4
Liver injury	3
Mesenteric injury	3
Colon or rectum injury	2
Stomach injury	1
Renal vein injury	1
Hepatic vein injury	1
Splenic vein injury	1
Small intestine	1
Diaphragm injury	1
Common carotid artery injury	1
Extensive muscle lacerations	1
Common iliac vein	1
No injuries identified	2
Surgical procedures (multiple answers allowed)	
Ligation of transected vessels	9
Primary simple closure of the digestive tract	2
Hepatorrhaphy	2
Emergency department thoracotomy	2
Vascular anastomosis	1
Intestinal anastomosis	1
Hepatotomy	1
Simple diaphragm closure	1
Primary simple closure of vessels	1
Negative abdominal exploration	2 (1 carried out laparoscopically)

indication was shock, and the most frequently injured organ and surgical procedure were liver or external jugular vein, with ligation of the disrupted vessels, respectively. There were two negative abdominal explorations, one of which was carried out laparoscopically.

DISCUSSION

THIS STUDY SHOWS that just 5% of all patients admitted with traumatic injuries had penetrating injuries, in a tertiary care emergency center in Japan, a country with a very low crime rate but high suicide rate. One characteristic feature is the very small number of gunshot wounds, with just one patient suffering a gunshot wound over a 3-year period in this facility. Although guns are commonly used weapons in penetrating injuries around the world, there are almost no gunshot wounds in Japan. Among self-inflicted penetrating injuries, there were no gunshot injuries. Bukur *et al.*[6] reported that gunshot wounds accounted for 19.5% of all patients with self-inflicted penetrating injuries in a level 1 trauma center in the USA. The Swords and Firearms Control Law bans carrying or possessing guns in Japan, and this law has excellent compliance.[1, 2]

Table 2 shows that the proportion of men was larger than women who had other causes of injury, such as accidents, work-related incidents, and assault, compared to self-inflicted injuries, although the number of men is usually more than women for self-inflicted penetrating injuries.[6] Relatively minor penetrating injuries to the wrist can be inflicted by both men and women, which affected the proportion seen in this study. Most accidents were related to home activities with lawnmowers or saws, which increased the proportion of men involved.

The most frequent cause of penetrating injuries was self-inflicted wounds (Table 1). More than one-third of all penetrating injuries in this review were self-inflicted. Suicide is a major social problem in Japan with more than 15,000 people taking their own lives every year.[5] This is approximately three times more than the number of traffic accident deaths. Suicide is the leading cause of death in people from 15 to 39 years old in Japan. Penetrating injuries are a less common mechanism for suicide attempts compared to others such as toxic ingestion or hanging. However, the number of suicide attempts is so large, that the number of patients with self-inflicted penetrating injuries may be considerable. Suicide prevention is the key to decrease not only overall mortality, but also the number of penetrating injuries. In response to the high rate of suicide, the Japan Cabinet Office started a concerted government-funded effort to reduce suicides and formally support suicide prevention in 2006.[7] The number of suicides is somewhat decreased from a high of more than 34,000 in 2003 down to 27,200 in 2013, due to these efforts.[8] The number is still higher than the average of approximately 23,000 from the 1970s through to the late 1990s.

The most frequent site of injury among self-inflicted penetrating injuries was the abdomen, not the extremities, with a significant difference compared to other causes of penetrating injuries (Table 3). Harakiri, or Seppuku, which means cutting one's own abdomen with a short knife, was frequently used as a means to an honorable death during previous eras in Japan. Patients who stab themselves with a knife in the abdomen might be familiar with Harakiri, although the Japanese attitude toward Harakiri has greatly changed and it is very rare.

Even in a country with a low crime rate, self-inflicted penetrating injuries, which account for 23% of all patients requiring surgical intervention such as thoracotomy or laparotomy, can be a significant cause of traumatic injuries, and requires that surgeons are familiar with the management of such injuries. Hondo *et al.* analyzed data from the National Trauma Data Bank in Japan and found that after introduction of the Japan Advanced Trauma Evaluation and Care course, which is a modified version of the Advanced Trauma Life Support course, the mortality of patients with traumatic injuries who underwent surgery was not improved, although the total mortality rate decreased. They concluded that the surgical management of traumatic injuries in Japan may not be adequate, and that improved definitive treatment is needed.[9]

The Advanced Trauma Operative Management (ATOM) course has been offered since 2008 in Japan. The ATOM course provides a structured approach to the surgical management of traumatic injuries, especially penetrating injuries.[9] The value of the ATOM course has been reviewed in previous studies.[10,11] Table 3 shows that abdominal injuries are the most frequent, and it is important that surgeons in Japan are prepared for the management of penetrating abdominal traumatic injuries.

In this study, negative abdominal explorations (one laparotomy and one laparoscopy) were carried out in 2 hemodynamically stable patients of a total of 17 patients with peritoneal violation (12%). Leppäniemi *et al.*[12] reported that mandatory laparotomy results in a 40% negative laparotomy rate and minor complications such as wound infections occur in 20% of patients who underwent a negative laparotomy. Biffl *et al.*[13] showed that non-operative management with close observation is preferable for hemodynamically stable patients who suffer stab wounds found to have peritoneal invasion on wound exploration, but do not have evidence of peritonitis or evisceration.

We agree that for hemodynamically stable patients without peritonitis, careful observation is the best choice in most patients with stab wounds. However, close follow-up may be difficult in small emergency centers. Penetrating trauma patients must be thoroughly evaluated when they are transported to an emergency center. The lack of a formal trauma care system in Japan results in a lack of concentrated trauma care centers. Surgeons dedicated to trauma surgery are dispersed to many hospitals. This supports the need for an effective system of trauma care, which would concentrate surgeons at specialized trauma facilities.

This study has some limitations. This retrospective and single center study does not necessarily reflect all penetrating traumatic injuries in Japan. People who commit suicide successfully and are brought to forensic departments directly were not counted in this review. Further study is warranted in the future. However, it is hoped that this study will contribute to a better understanding of penetrating injuries and inform acute care surgeons in Japan, a country with little crime but a high suicide rate.

CONCLUSIONS

IN OUR STUDY in a tertiary emergency center in Japan, penetrating traumatic injuries accounted for 5% of all trauma admissions, and there was only one patient who suffered a gunshot wound. Self-inflicted penetrating injuries were the most common cause of injury in these patients. Approximately one-quarter of all patients with penetrating injuries underwent thoracotomy, laparotomy, or surgical procedures for neck and proximal extremity injuries, with an ISS ≥9. Thus, acute care surgeons must be familiar with the surgical management of penetrating trauma, even in a country with a very low crime rate, due to the high rate of suicide attempts.

CONFLICT OF INTEREST

NONE.

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NONE.

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